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Repackaging of Savannah River Site “Black Box” TRU Waste

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ABSTRACT

Historically, large items of TRU Waste, which were too large to be packaged in drums for disposal have been packaged in various sizes of custom made plywood boxes at the Savannah River Site (SRS), for many years. These boxes were subsequently packaged into large steel “Black Boxes” for storage at SRS, pending availability of Characterization and Certification capability, to facilitate disposal of larger items of TRU Waste.

There are approximately 107 Black Boxes in inventory at SRS, each measuring some 18' X 12' X 7', and weighing up to 45,000 lbs. These Black Boxes have been stored since the early 1980s.

The project to repackage this waste into Standard Large Boxes (SLBs), Standard Waste Boxes (SWB) and Ten Drum Overpacks (TDOP), for subsequent characterization and WIPP disposal, commenced in FY04. To date, 10 Black Boxes have been repackaged, resulting in 40 SLB-2's, and 37 B25 overpack boxes, these B25's will be overpacked in SLB-2's prior to shipping to WIPP.

This paper will describe experience to date from this project.

INTRODUCTION

Since the 1970's, Transuranic (TRU) waste has been retrievably stored in at the Savannah River Site for eventual disposal at the Waste Isolation Pilot Plant in Carlsbad, New Mexico. Approximately fifty percent of the stored inventory of 11,000 m³ is stored in containers other than 55 gallon drums. This non-drummed inventory is referred to as the HA TRU inventory. This waste is currently packaged in a variety of containers, with the majority of the volume in 18 ft x 12 ft x 7 ft steel boxes “Black Boxes”. The HA TRU inventory also includes 3000 drums of TRU waste containing mainly heat-source plutonium that fail the current TRUPACT II limits. The original Site plan was to construct a major TRU Waste Facility that will process, repackage, remediate, characterize and ship all of this waste to WIPP. The cost to construct such a facility for this limited inventory was estimated to require Line Item Project funding up to \$450M.

BNG America, Savannah River Corporation, the operating contractor for the Waste Management Area Project at SRS, has performed an internal review of the repackaging project and concluded that a dedicated new facility for repackaging was not cost efficient therefore, plans have changed, consistent with acceleration initiatives which now call for this waste to be disposed of sooner than any Line Item Project schedule would allow. In order to achieve an accelerated schedule for the safe and cost efficient repackaging of the black boxes a plan to “divide and conquer” the HA TRU waste inventory by seeking out a range of solutions was implemented. In other words, divide the waste into more discrete elements and identify existing on-site facilities or temporary facilities where the necessary activities could be safely performed to meet the WIPP requirements.

In simplest terms, the inventory consists primarily of heat-source TRU Waste and waste contaminated mainly with weapons grade plutonium in containers. Gram quantities vary from container to container allowing for certain processing options to take place in a Hazard Category III facility while other containers will require a Hazard Category II facility. Thirty percent of the inventory is RCRA hazardous mixed TRU waste. The waste was generated at various operating and laboratory facilities on the SRS Site.

To meet the WIPP Waste Acceptance Criteria, the non-drummed waste will need to be repackaged into one of three WIPP approved containers that are available for use. The smallest is the WIPP Standard Waste Box (SWB) that is shippable in the TRUPACT II. The next size container is the WIPP Ten Drum Overpack (TDOP) that is shippable in the TRUPACT II. The largest container is the WIPP Standard Large Box-2 (SLB-2) that is only shippable in the TRUPACT III. Waste will require the removal of prohibited items such as excessive free liquids, sealed containers > 4 liters, unpunctured aerosol cans and containerized liquids. In addition, containers need to be vented and a small portion of the waste will need to be size reduced for placement into the nominal 5' x 5' x 8' SLB-2.

Current plans call for all the waste to be repackaged into WIPP compliant containers by the end of FY09. Therefore, the project has focused on identifying and preparing the SRS facilities to support the program, developing work off strategies, identifying facility and Authorization Basis modifications and reviewing waste inventory documentation. Preparatory work also focused on performing facility modifications, developing operating procedures, and obtaining the necessary equipment to unpack and remediate the waste. Deployment of a field team to investigate container handling, unpacking and remediation techniques began during FY04. Currently the project is dedicated to repackaging and remediation activities including size reduction, installation of TRUPACT III loading capability for SLB-2's and development, installation and certification of the large container WIPP characterization equipment. FY06 will be dedicated to continuing unpacking and remediation of waste and commencing WIPP characterization of all the repackaged waste, in preparation for shipment to WIPP.

Before the remaining high activity (principally Pu-238) non-drummed waste can be shipped, new technologies and methods are needed for performing large container assay and X-ray. The WIPP characterization and certification equipment for non-drummed waste is expected to arrive at SRS in FY06. This \$6.5 million project is expected to be operational in FY06.

REPACKAGING OF BLACK BOXES

The TRU waste inside the black boxes was generated at SRS mainly during deactivation of the "old" HB-Line (OHBL) facility, the OHBL facility mission was primarily dissolution and recovery of uranium, plutonium and neptunium scrap to produce Np-237 and Pu-238 products. All the TRU waste generated during the deactivation project was appropriately dispositioned using procedures that ensured appropriate record keeping, which is compliant with TRUPACT payload properties. Typically this includes, for previously generated waste, knowledge of chemical, physical, gas generation and nuclear properties of the waste.

All SRS black box waste was generated from well characterized processes, bagged for contamination control and packed into oversize plywood boxes then overpacked into the steel black boxes. With the exception of possible rainwater intrusion from outdoor storage it is not anticipated that free liquids will be present in the waste boxes, additionally the procedures applied during operation and deactivation of the waste generating facility prevented the inclusion of reactive or corrosive media in the TRU waste stream.

Development of the Repackaging Process

The initial demonstration work performed at SRS by BNG America Savannah River Corporation to repack the black boxes was performed mainly to determine the potential for airborne contamination within the black box. Secondly, the potential for the presence of free liquids in the black box was to be determined. Finally, the potential hazard presented by contamination on the exterior surfaces of the inner plywood boxes was evaluated. All of these factors were applied in the planning effort to develop procedures and select subsequent existing on site facilities for the repackaging of the higher activity waste black boxes. A parallel project was performed in one of the Sites Canyon areas, a Hazard Category II facility. This was a pilot project to demonstrate the functionality of the repackaging effort for higher activity black boxes.

The successful completion of the repackaging pilot project to repack two large steel boxes in the Canyon area confirmed the efficacy of utilization of existing on site facilities for this task. A total of four of these large steel black boxes (18 ft x 12 ft x 7 ft OD) were repackaged as part of the Pilot Project. They included waste items such as glove boxes, process vessel, ventilation systems, etc., stored in inner plywood boxes. The total original legacy inventory for these large black boxes was 107 (40 – Pu-239 & 67 – Pu-238). Additionally seventeen of the large containers have been dispositioned to LLW (6 – Pu-239 & 11- Pu-238).

Following completion of the pilot project the repackaging effort was transferred to a second SRS Canyon which will allow Hazard Category II work. To date this Canyon facility has repackaged an additional 5 black boxes generating 30 SLB-2 containers.

Repackaging Methodology

Repackaging of the black boxes in the Hazard Category III area and in the Canyon for the Hazard Category II boxes, follows a number of well defined process steps. These steps are sequentially performed to repack the black boxes and are comprised of the following:

- Load black box into the Canyon repackaging area, establish radiological controls, inclusive of radiological barriers, personnel protective equipment, contamination controls and radiological monitoring equipment.
- Confirm functionality of visual recording equipment which is used to provide a visual record of the repackaging operations and then commence removal of the bolts that hold lid on the black box.
- Once the box lid is removed the first task is to verify the rainwater intrusion level, which is to be expected in some of the black boxes. If free liquids are present, absorption or liquid collection will take place. Once free liquids and contamination are addressed, the next step is to determine the structural integrity of the inner plywood boxes for removal from the black box.
- Attempts are made to use any rigging that was left in place to facilitate the extraction of the inner containers. If a plywood box is structurally sound, rigging is put in place, if necessary, to remove the plywood box from the black box. Capabilities for breaking down the black box from around its contents if the box is structurally unsound for lifting are available.
- Some of the black boxes contain plywood boxes that are too large to fit the SLB-2's and in this circumstance the waste is removed from the plywood box and loaded directly into the SLB-2. A

number of plywood boxes contain monolithic waste items which are too large to fit the SLB-2's and therefore the waste items are disassembled in order to fit into a SLB-2. Throughout these intrusive remediation steps workers are dressed in PPE consisting of plastic protective suits with supplied breathing air while performing the disassembly work.

- Once the plywood boxes and their contents are packaged in WIPP compliant containers they are staged in a waste holding area for subsequent WIPP characterization, when the characterization systems become available.

Characterization of the SLB-2's

The characterization systems are currently being developed under a separate DOE contract and will be supplied to BNG America as government furnished equipment. The system is comprised of modular units, which will facilitate their redeployment to other DOE projects after completion of the SRS TRU waste mission. The system has 3 component parts, these are:

- Large Box NDE system. This is a non intrusive visual examination unit, which uses a linear particle accelerator to produce the interrogative X rays. It has two sensors, one is a non linear detector array for gross imaging and the other an area detector array for specific, higher resolution, interrogation of areas within the SLB-2's. The system will be located in an existing concrete cell to provide radiological controls and has numerous interlocks to minimize personnel exposure to ionizing radiation. The unit will be capable of interrogating all three of the approved WIPP shipping containers.
- Large Box Gamma Detector. This has 4 HPGe detectors, which utilize two Co-60 sources and two opposing NaI detectors for matrix correction. Initially the SLB-2 is loaded on a trolley and drawn through the matrix correction array and then it is withdrawn past the active HPGe system thereby performing the assay measurement.
- Passive Neutron Counter. This utilizes a drawbridge orifice to access an internal polypropylene chamber housing He-3 detectors, once the item is loaded the drawbridge containing its array of He-3 detectors is drawn up, thus surrounding the item on six sides with detectors. A Cf-242 source is drawn through a Teleflex tube to be exposed at various positions within the chamber to provide a matrix correction.

These systems are scheduled to be delivered during FY06 and will have waiting a backlog of SLB-2's ready for characterization.

Progress to date

As previously noted, to date ten Black Boxes have been repackaged into 40 SLB-2's and 37 B-25's, the process began using the Hazard Category III facility and simply performed repacking operations on the unopened inner plywood boxes. The campaign then moved into the Hazard Category II facility to commence, where necessary, opening of the inner plywood boxes and repackaging the individual waste items therein. Finally a Black Box known to contain a massive waste item was processed in order to demonstrate the size reduction capability of the program, the item was disassembled and repackaged into SLB-2's. Upon completion of this work the repackaging effort was transferred to a second Canyon and steady state operations established.

The program has been so successful that operations may soon expand to two shift operation, increasing productivity and shortening the schedule for completion of the Black Box repackaging mission at SRS.

Table 1 below is a summary of the successful repackaging effort and Table 2 is a summary of the future Black Box processing operations.

Table 1. Black Boxes Repackaged to Date.

Sequence #	Black Box #	Completion Date	Repack Location	Repack Inventory
1	610948	7/04	Haz Cat III Facility	15 B25OP
2	610947	9/04	Haz Cat III Facility	16 B25OP & 1 SLB-2
3	610944	11/04	Haz Cat II Canyon	5 SLB-2
4	610949	12/04	Haz Cat III Facility	6 B25OP
5	610945	12/04	Haz Cat II Canyon	4 SLB-2
6	571644	8/05	Haz Cat II Canyon	6 SLB-2
7	570554	10/05	Haz Cat II Canyon	6 SLB-2
8	570553	10/20	Haz Cat II Canyon	6 SLB-2
9	570555	11/05	Haz Cat II Canyon	6 SLB-2
10	571708	12/05	Haz Cat II Canyon	6 SLB-2

PATH TO SUCCESSFUL COMPLETION OF THE REPACKAGING PROJECT

There were originally 90 Black Boxes that required repackaging of inner plywood containers to allow for disposal at WIPP (seventeen were disposed of as LLW). Three WIPP approved containers are available for use and selection of the appropriate container is determined by geometry and volume of the waste being repackaged. In order to make such a determination, the contents of the 90 Black Boxes were reviewed and the following recommendations developed.

There are 43 Black Boxes that contain non-mixed Pu-238 waste. Forty-two of these Black Boxes each contain 6 standard size plywood boxes (nominal 60"x60"x72"). The forty third Black Box contains only two of these standard size plywood boxes. The SLB-2 was designed to accommodate these standard size plywood boxes. In order to minimize risk to the workforce and to minimize the number of WIPP containers requiring characterization, it is planned that all 254 of these plywood boxes be repackaged into the WIPP SLB-2 containers.

There are 13 Black Boxes that contain mixed Pu-238 waste. Six of these Black Boxes each contain 6 standard size plywood boxes (nominal 57"x57"x57"). It is planned that all 36 of these plywood boxes be repackaged into the WIPP SLB-2 containers. The seven remaining mixed Pu-238 Black Boxes contain uniquely sized plywood boxes. For these plywood boxes the following repackaging strategy is planned. Repackage the plywood boxes into the smallest available WIPP container that can satisfy the WIPP transportation and disposal limits. Implementing this strategy would minimize size reduction activities.

These seven Black Boxes contain 62 plywood containers. Repackaging this waste could result in 45 to 65 WIPP containers.

There are 12 Black Boxes that contain non-mixed Pu-239 waste with plywood box information available. In packaging the Pu-239 Black Boxes, no standard size plywood box was used. The contents of two of these Black Boxes have already been repackaged into SLB-2 containers. The remaining 10 Black Boxes contain 132 plywood containers of which 32 should fit into SWB containers. It is planned that the remaining 100 plywood boxes be repackaged the into the smallest available WIPP container that can satisfy the WIPP transportation and disposal limits.

There are 20 Black Boxes that contain mixed Pu-239 waste with no plywood box information available. It is assumed that these Black Boxes were loaded with plywood boxes similar to those placed into the 12 Black Boxes that contain non-mixed Pu-239 waste. For these plywood boxes the same repackaging strategy is recommended. Repackage the plywood boxes into the smallest available WIPP container. Implementing this strategy would minimize size reduction activities.

Lastly, there are two Black Boxes that contain Am 241 waste. One Black Box contains Am 241 mixed waste with no plywood box information available. The other Black Box contains non-mixed Am 241 waste and contains 14 plywood containers. For these plywood boxes the same repackaging strategy is recommended. Repackage the plywood boxes into the smallest available WIPP container.

Planned Production Rate is as follows:

Table 2. Schedule for future Black Box Repackaging

Location	Number of Black Boxes Processed	Repackaged Inventory	WIPP shipping container	Scheduled Completion Date
Haz Cat III Facility	15	120	SLB-2	FY 06
Haz Cat II Canyon	22	47	SLB-2	FY06
Haz Cat III Facility	12	96	SLB-2	FY07
Haz Cat II Canyon	25	150	SLB-2	FY07
Haz Cat II Canyon	8	64	SLB-2	FY08

CONCLUSION

The critical mission to disposition TRU waste from the Savannah River Site to WIPP in accordance the SCDHEC milestones, is being delivered ahead of schedule by BNG America Savannah River Corporation. The innovative steps employed, such as using existing on site infrastructure for the repackaging of the non WIPP compliant Black Boxes, has provided an opportunity to accelerate disposition this complex waste stream drastically reducing previous project baseline cost estimates and will facilitate completion of the SRS TRU waste mission decades ahead schedule.

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Upon completion of the SRS mission the Black Box repackaging methodology and underpinning innovative technology, such as the SLB-2 non destructive examination and assay equipment will be available as a proven system for deployment elsewhere in the DOE complex.

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